REMARKS

In lieu of filing an appeal, Applicant hereby submits the claim amendments above and the following remarks, in view of which, reconsideration is requested.

Claims 1-14 and 17-20 remain in this application, of which claims 1 and 8 are independent. Claims 21 and 22 have been added, bringing the total number of claims to 20. No fee is believed due for claims for this amendment.

Examiner Interview

Applicant thanks the Examiner for granting the telephone interview of October 2, 2007 to Applicant's counsel. No agreement was reached on the claims' novelty and nonobviousness in view of the cited art, however the discussion informed the Applicant's claim amendments and the arguments below, which reply to the rejections of the 23 March 2007 Office Action.

Rejection Under 35 U.S.C. §102

Claims 1, 2, 8, 9 and 17-20, of which claims 1 and 8 are independent, were rejected under 35 U.S.C. §102 in view of Sasaki[1]. This rejection is respectfully traversed.

Claims 1 and 8, as amended, recite in substantial part:

> *generating a single channel image for each of two input images according to a function that measures, for each pixel, occurrence of a desired characteristic in a region around the pixel, other than luminance alone, in the input images at each pixel location to provide a single value for each output pixel in the single channel image from a range of values that represent a likelihood of the occurrence of the desired characteristic; and*
>
> *computing an estimate of motion of the desired characteristic between the two images using a gradient-based method that uses the single channel images generated for the two input images and a constraint that a total of the desired characteristic is constant from one image to a next image.*

As noted in the specification, optical flow computations "generally are gradient-based or correlation based."[2] Conventional *gradient-based* optical flow techniques (eg, such as described on pp. 441-450 of the Beauchemin article incorporated by reference) compute a motion vector field from two input images based on an assumption of the conservation of luminance using

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[1] U.S. Patent 6,246,961 to Sasaki, et al.
[2] Applicant's specification, par. [0013]

spatial and temporal partial derivatives in the "optical flow constraint equation" (see Section 2.1 on pp. 435-436 of Beauchemin). As noted in the specification, "[i]n some neighboring images in a video or film sequence, the constant brightness constraint does not hold."[3] Notably, the presently claimed invention estimates motion *using a gradient-based method that uses a constraint that a total of a desired characteristic, other than luminance alone, is constant from one image to a next image.* In one embodiment, the desired characteristic is *edge magnitude*, which may be computed for each pixel by combining the output of differential operators (horizontal and vertical edge operators) using, for example, algorithms such as described in paragraphs [0021-0043].

Sasaki teaches a type of correlation-based motion estimation. According to Sasaki, "corresponding horizontal edges in the respective images are detected with a correlation window."[4] More particularly, "an edge image . . . is obtained [from which] points having the same y-coordinate values are extracted to provide continuous horizontal edges as noticeable edges."[5] "These horizontal edges are thinned . . . by extracting for example only points of the same y-coordinate values at the edges closer to one vehicle. Such a thinned horizontal edge is used as the noticeable edge."[6] "[A] large correlation window . . . is set around a noticeable edge . . . and . . . is used to detect the corresponding noticeable edge . . . in the [other] image."[7] "Optical flow is then detected from the horizontal edges [i.e., the noticeable edges]."[8] More particularly, "because the optical flow from every point in the thinned horizontal edge has, at the starting point, the same y-coordinate value and has the same movement in the y-direction . . . one optical flow F can be detected between the corresponding thinned horizontal edges in the two images."[9]

Sasaki makes an assumption that the other vehicle travels "substantially parallel to the Z-axis" and therefore "the component of the direction of X-axis of the optical flow F of the other vehicle may substantially be ignored."[10] A similar omission of the other vehicle's movement

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[3] specification, pr [0003].
[4] *Sasaki*, col. 8, lines 34-35.
[5] *Sasaki*, col. 6, lines 44-47.
[6] *Sasaki*, Col. 6, lines 46-51.
[7] *Sasaki*, col. 6, line 64 to col. 7, line 1.
[8] *Sasaki*, col. 8, lines 40-41.
[9] *Sasaki*, col. 7, lines 5-10.
[10] *Sasaki*, col. 5, lines 54-61.

along the Y-axis is made from the method's calculations.[11] These assumptions permit a vehicle collision time to be calculated from only the original y-coordinate of the noticeable edge and the magnitude v of the component of the direction of y-coordinate of the optical flow[12] (perpendicular to the thinned noticeable edge.) Also, Sasaki discloses the use of edge size only in the context of determining what time interval should be utilized in obtaining the two images, and (in contrast to the presently claimed invention) not in estimating motion.[13]

The Office Action interprets the term *gradient-based method* as being disclosed by Sasaki's computation of the x or y component of the "optical flow" speed vector, and asserts that "a more specific description of a particular gradient based method might overcome Sasaki." (p. 2) Applicant respectfully submits that such a reading of claims 1 and 8 ignores the significance of the remainder of the second limitation, where the more specific description of the gradient method sought is found. In particular, the recited *gradient-based motion estimation method* is one *that uses a constraint that a total of a desired characteristic, other than luminance alone, is constant from one image to a next image.*

Sasaki does not, as is asserted in the Action, disclose this limitation. Sasaki estimates motion utilizing a two-window correlation-based technique, such as shown in Figure 6 and described in the associated text.[14] Mathematical algorithms for *gradient-based* functions, which utilize the optical flow constraint equation, are distinct from Sasaki's approach of seeking a minimum of window square differences. Moreover, Sasaki does not constrain the total of some desired characteristic from one image to the next, such as *edge magnitude* (as recited in claim 2) by processing a gradient based optical flow on the edge magnitude. Rather, as noted above, Sasaki recognizes that edge size will change with proximity of the vehicles, but discloses only using this property to change image sampling time intervals.

The Applicant respectfully submits that the use of the term "optical flow" in Sasaki is merely coincidental and does not relate to "optical flow constraint equations" such as utilized in gradient-based methods. Sasaki's computations can only be considered "gradient-based" in that one component (perpendicular to the detected edges) of a speed vector is computed between two

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[11] *Sasaki*, col. 6, lines 8-10.
[12] *Sasaki*, col. 6, lines 28-30.
[13] *Sasaki*, col. 8, lines 7-15.
[14] *Sasaki*, col. 6, line 64 through col. 7, line 27.

corresponding edges[15] that involves ignoring the components of motion in two of three possible directions. This calculations described in columns 5 and 6 are merely first order derivative geometric calculations, and are not based on the *constraint on the total of a desired characteristic, other than luminance alone, in a gradient-based method.*

None of the equations in Sasaki has any indication of such a constraint. Sasaki does not teach that a total measure of some characteristics, such as the edge magnitude, is constant from one image to the next.

Accordingly, this rejection of independent claims 1 and 8 is respectfully traversed.

Claims 2, 9, 17, 18, 19 and 20 are dependent claims that are allowable for at least the same reasons.

Additionally, regarding dependent claims 19 and 20, the technique in Sasaki does not produce, *for each pixel in an image, a vector that describes the motion for the pixel from one image to the next.* Sasaki only produces a single vector component in one direction for each pair of corresponding edges that is detected, perpendicular to the edges. Accordingly, dependent claims 19 and 20 further distinguish the invention from Sasaki.

Rejections Under 35 U.S.C. §103

Dependent claims 4-6 and 11-13 were rejected under 35 U.S.C. §103 in view of Sasaki and U.S. Patent 4,924,310 ("Von Brandt"). Dependent claims 3 and 10 were rejected under 35 U.S.C. §103 in view of Sasaki and U.S. Patent Publication 2002/0159749A1 ("Kobilansky"). Dependent claims 7 and 14 were rejected under 35 U.S.C. §103 in view of Sasaki, Von Brandt and Kobilansky.

These rejections are respectfully traversed as claims 3-7 and 10-14 are allowable for at least the same reasons as the claims from which they depend.

Regarding the dependent claims 3, 7, 10 and 14, these claims are also allowable for the following additional reasons.

The Action states that Kobilansky discloses a motion estimation technique that takes into account the proximity to a color, but suggests that limitation-clarifying language in Applicant's specification exists in paragraphs [0012] and [0017]. Further, claims 7 and 14 have been amended to clarify that the proximity to a color function operates on *a region around each pixel.*

[15] *Sasaki*, Col. 4, lines 49-50.

Moreover, Kobilansky only teaches, at best, that motion estimation should take into account the proximity to a color. Kobilansky merely says that the "region r+d(r) in target frame should have image properties like . . . color close to those of the region r in the reference frame." This portion of Kobilansky does not teach *generating a single channel image based on a desired characteristic where that desired characteristic is color proximity*. The Examiner is respectfully requested to indicate where Kobilansky specifically teaches generating such a single channel image. The Action merely refers to paragraph [0015] from which the relevant language is quoted above and which does not teach generating a single channel image based on color proximity.

Additionally, there is no explanation of how Sasaki could be modified so as to replace or modify Sasaki's computation of a speed vector between detected edges with some other calculation (not taught by Kobilansky) that uses color proximity. The Action does not describe what this proposed modification would have been in sufficient detail to permit the claims to be compared to it.

Accordingly, claims 3, 7, 10 and 14 are distinguishing over Sasaki (or Sasaki and Von Brandt) and Kobilanksy.

Finally, new claims 21 and 22 explicity recite use of an *optical flow constraint equation* in the gradient-based method.

Conclusion

In view of the foregoing remarks, this application should now be in condition for allowance. A notice to this effect is respectfully requested. If the Examiner believes, after this reply, that the application is not in condition for allowance, the Examiner is requested to call the Applicants' attorney at the telephone number listed below.

If this response is not considered timely filed and if a request for an extension of time is otherwise absent, Applicants hereby request any necessary extension of time. If there is a fee occasioned by this response, including an extension fee, please charge any fee to **Deposit Account No. 50-0876.**

Respectfully submitted,

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